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A Low-Cost Fish-Delivery Method for Planting Fish via Helicopter

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Abstract.—Our inexpensive method to load and to transfer fish via helicopter proved efficient for mass outplanting of juvenile chinook salmon (*Oncorhynchus tshawytscha*). Fish loads were transferred to a preloading holding box at the staging site and then rapidly dispensed into a helicopter-transported fire bucket modified for water aeration. Rapid turnaround time and use of the fire bucket significantly reduced costs and fish handling for mass outplanting of fish in remote areas.

Off-station releases of hatchery fish often require airlift to successfully distribute large numbers of fish to remote, roadless locations. Helicopter fish-delivery methods typically involve specially designed fish containers transported inside or below the aircraft (Conley 1976; Hauck 1986). Here we describe a relatively simple, low-cost delivery method that employed water aeration and commercially available equipment. We effectively used this delivery method for mass outplanting of fingerlings of chinook salmon (*Oncorhynchus tshawytscha*) by helicopter to the remote upper Elwha River, Olympic National Park, Washington.

The fish-delivery method consisted of a fire bucket that, while suspended from a helicopter (Hughes 500D), was loaded with a premeasured volume of water and number of fish from a transportable holding box. The fire bucket, designed principally for helicopter use in forest-fire fighting, was manufactured by SEI Industries in Richmond, British Columbia (Bambi model 1012). The bucket consisted of a collapsible nylon and polyester shell guyed to a 15-m cable that was attached to the helicopter (Figure 1). When filled about 80% full (to avoid splash-out and fish loss during transport), the bucket held 300 L of water and 36 kg of fish, a total load of 336 kg. We strapped an oxygen bottle measuring 48 by 18 cm (1,133-L capacity) to the outside of the bucket in a reinforced vinyl bag. Oxygen was dispensed at a rate of 4 L/min by a regulator connected to a 2.75-m length of 3.8-cm-diameter flexible diffuser tubing secured to internal rigging in the bucket (Figure 1). At release, the dump valve opened downward and turned inside out through the bottom of the bucket, quickly dispensing water and fish.

The holding box, constructed of 1.9-cm-thick plywood, was placed onto the back of a pickup truck for transport in the staging area. The box (Figure 2), which measured 0.9 m long, 0.8 m wide, and 0.8 m high, also held 300 L of water and 36 kg of fish. Oxygen was delivered via the method described above for the bucket. A flap gate and hose coupling were located at the low point of the box, which allowed rapid release of fish directly into the fire bucket via a 6-m length of 40-cm-diameter flexible hose.

In 2 d, we distributed approximately 428,000 chinook salmon fingerlings (2.7-g fish) to 30 Elwha River sites in a 35-km reach up to 50 km from the staging site. To reduce helicopter flight time, we staged a hatchery fish-transport vehicle at a road downstream of the planned release area. We transferred 300 L of fresh river water (of equivalent temperature as release sites) and 36 kg of fish from the hatchery vehicle into the holding box immediately prior to arrival of the helicopter. At loading, the helicopter hovered while fish were transferred from the holding box to the bucket; the bucket was placed in a half-filled, 760-L, polyethylene fish tote to avoid fish loss and to support the bucket. Loading of the bucket took less than 3 min, which significantly reduced helicopter flight time, as well as handling and transport time for fish.

At the release site, the helicopter descended until the bucket rested on the water's surface, where it remained while the bottom was tripped open to release the fish. The 15-m bucket cable provided extra clearance for the aircraft when fish were released in space-limited sites on the river. Maximum time for helicopter transport to the most remote planting site was only 20 min. After release, the expected return time was radioed to the staging area to allow preloading of fish from the hatchery vehicle into the holding box for the next outplant.

Fish distributed in this manner survived well.

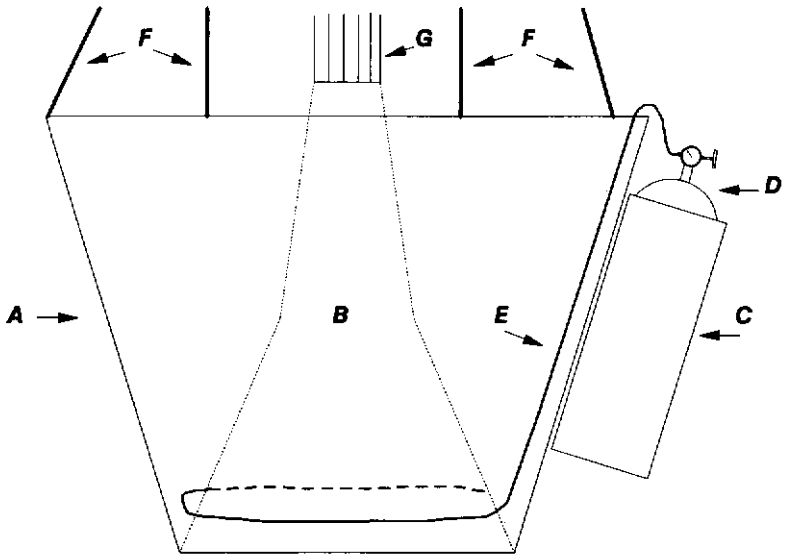

FIGURE 1.—Diagram of fire bucket, with oxygen-diffuser system, used for transferring fish. Symbols are as follows: A, fire bucket; B, fabric dump valve; C, oxygen-bottle holding bag; D, oxygen bottle and regulator; E, oxygen-diffuser line; F, bucket guylines to helicopter; G, dump-valve release lines.

Intensive monitoring of chinook salmon emigration from the release sites over the following 15 months (Wunderlich and Dilley 1990) indicated good survival (29% of the fingerlings survived to smolt stage) and no evidence of fish displacement from the release sites or transport-related injury. Although fish were not examined immediately after release, we have previously outplanted fingerlings of coho salmon (*O. kisutch*) and steelhead (*O. mykiss*) to the same area in an identical manner (except hand-distributed from polyethylene fish totes without quick release) and have observed no indication of stress or injury in these species at release. We do not believe the quick-release feature of the fire bucket poses a hazard for fish when used in the manner described here. Application of oxygen as described should also reduce potential air-transport problems (Hauck 1986).

Advantages of this delivery method are that it uses relatively inexpensive, easily obtainable materials and reduces expensive helicopter flight costs through rapid bucket refill and use of premeasured fish loads in the holding box. Fish handling during the loading process is also minimized. Wide distribution of fish to remote sites is possible. Estimated material costs for the holding box and ox-

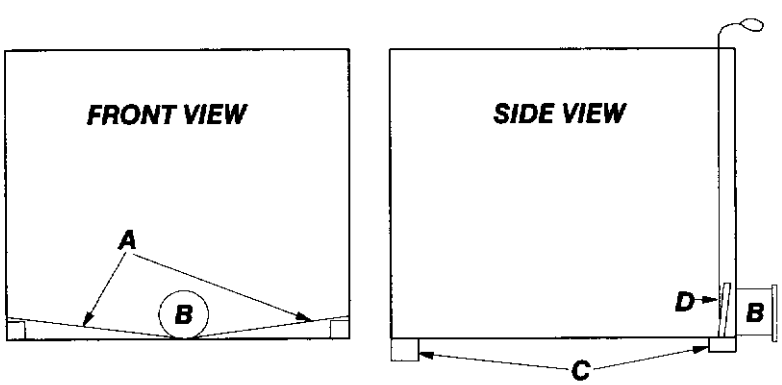

FIGURE 2.—Diagram of preloading holding tank. Symbols are as follows: A, beveled bottom; B, 10-cm outlet-hose fitting; C, slope blocks for drainage; D, hinged flap gate and pull rope.

ygen systems were less than US$200. Fire bucket purchase cost is $3,400, although many helicopter services have the same or similar fire buckets available at no cost when their flight services are used, as was the case here. A disadvantage of the method is that partial release of the fish load is not possible.

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